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THE BRYOLOGIST.

VOL. V. JULY, 1902. NO. 4.

THE PERISTONE. II.

BY A. J. GROUT.

In the article in the April, 1901, BRYOLOGIST the structure of the peristome in Georgia was discussed and some mention was made of its function. Since writing that article the hygroscopic activities of various types of peristome have been investigated with considerable care, necessitating a few further statements with reference to Georgia.

It has long been recognized that moss peristomes are strongly hygroscopic, *i. e*, respond by active motions to any changes in the amount of moisture in their tissues. It has also been recognized in a general way that the peristome played some part in the distribution of the spores and that its hygroscopic activity aids in this work, but very little attention seems to have been paid to the details or to the extreme nicety with which the peristome in different species has been adapted to do its work.

The spores of mosses must depend upon currents of air for distribution, hence they must be securely protected from rain or dew, which would mass and clot them together so that they would fall directly to the ground as soon as liberated, to say nothing of the danger of premature germination and decay.

Then, again, the spores must be liberated in small quantities so that they will not all be discharged at once, but take advantage of breezes from different directions and be sown at various seasons. They must also be well separated or sifted so as to be as widely separated as possible when they finally alight. This sifting of the spores is accomplished by various interesting devices which are specially prominent in mosses with pendent or horizontal capsules. In mosses with a double peristome the inner peristome is usually the sieve while the outer protects from water by closing hygroscopically in wet weather. In mosses with a single peristome both functions are often performed in a very interesting manner by the single row of teeth.

In mosses with upright capsules there is less need of a so finely meshed sieve. as the spores will not fall out but will be shaken out after the manner of lily seeds. To assist in this shaking the seta is often almost as elastic when dry as a steel wire and if bent to one side flies back when released with a jerk which scatters a small cloud of spores. In wet weather not only do the peristomes close, much after the manner of Chickweed pods, but the seta become soft and flaccid. As the highest development of this sifting arrangement is of no special advantage to mosses with an erect capsule, the inner peristome has become more or less vestigial in those mosses which have erect capsules, although they may be most closely related to species having cernuous or pendent capsules with a highly developed inner peri-

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The May BRYOLOGIST was issued May 1st, 1902.

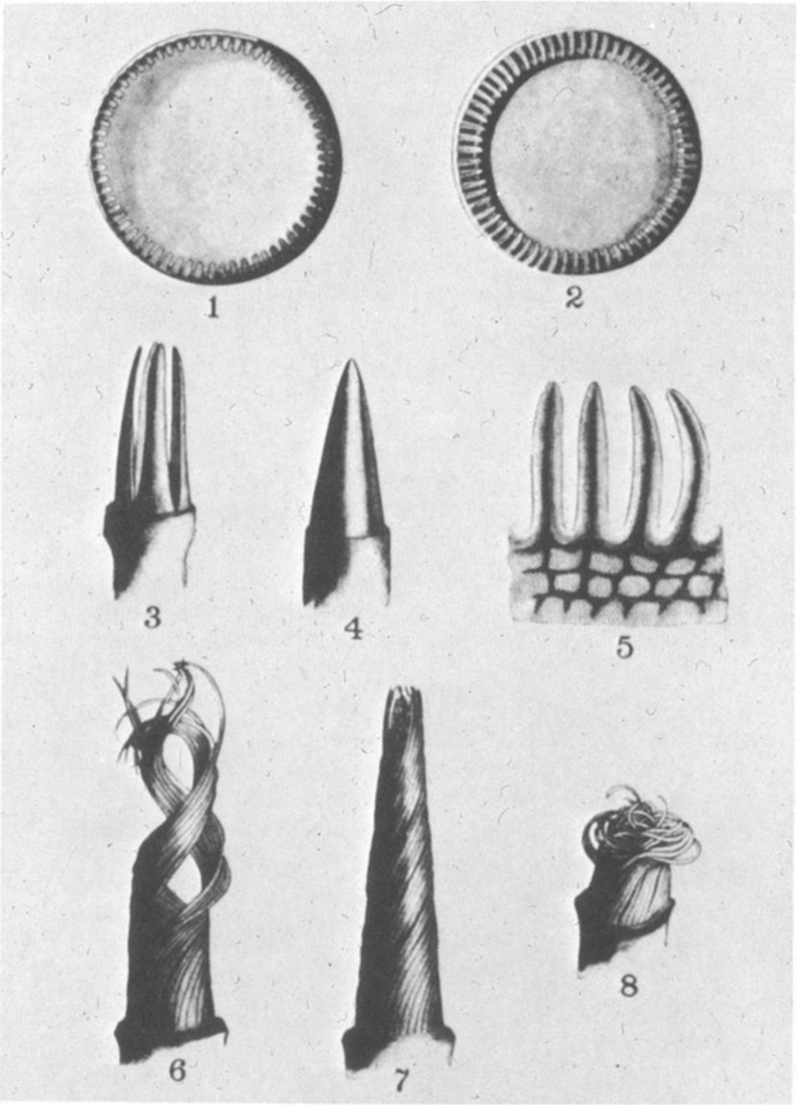

Plate V.

1. Moist peristome of *Polytrichum Ohioense* R. & C. 2. The same dry. 3 Dry peristome of Georgia. 4. The same wet. 5 Four teeth of the peristome of *Catharinea undulata* (L.) Web. & Mohr. 8. Dry peristome of *Barbula amplexa* Lesq. 7. A perfect peristome of the same moistened 6. An older peristome of the same moistened.

stome. *Philibert in his masterly treatment of the structure of the peristome calls attention to this correlation of symmetric erect capsule with a degenerate peristome but gave no explanation for the very evident facts. In this connection he mentions *Anomodon viticulosus*, *Habrodon Notarisii* and *Pylaisia polyantha*, calling attention not so much to the inner peristome as to the disappearance of the fine horizontal lines which mark the lower outer lamellæ of the typical hypnaceous peristome. Most striking illustrations of the correlation of the erect capsule with an imperfect developed inner peristome are furnished by *Brachythecium acuminatum* and its allies, *Plagiothecium latebricolor*, and the genera *Pylaisia*, *Entodon*, *Orthothecium*, *Isothecium* and *Homalothecium*. This also explains why Thuidium and its allies have a perfectly developed inner peristome while most of the Leskeaceæ, having erect capsules, have also imperfectly developed peristomes. I am inclined to think that this principle, modified by an annual habit of growth, or a very low minute growth, or both, will explain the lack, partial or complete, of a peristome in *Physcomitrium*, *Pottia*, *Pleuridium*, *Mollia viridula*, and other species of a similar habit and structure. It will also explain the degenerate condition of the peristome in *Orthotrichum* and its allies. However, it seems very probable that we not yet fully understand why mosses like *Pleuridium* do not seek the assistance of a peristome in their spore distribution and I would suggest that this question offers a fascinating field for investigation.

To return to *Georgia*; its capsules are erect and its four teeth well separated when dry as seen in Plate 5, Fig. 3. Dip one of the dry capsules in warm water for a moment and see the peristome close like a tiny vise, giving an almost comical impression of grim determination. (Pl. 5, Fig. 4).

In *Polytrichum* the teeth are 64 in number and of themselves are usually so short that they would have little effect upon spore distribution, but they are all attached by their tips to the expanded membranous upper end of the columella, forming a most effective and ingenious pepperbox, entirely automatic in action. When the weather is dry the teeth become shrunken in width and strongly incurved, the collumella also shrinks, pulling the ends of the teeth inwards (Pl. 5, Fig. 2). This leaves ample room for the spores to be shaken through the openings between the teeth. The columella shrinks more at the margin than in the central portion, causing it to assume the shape of a pieplate. This upturned margin of the columella also enables the teeth to remain attached to its edge in their changed position. In species of this family with more nearly erect capsules the teeth are longer and often fewer in number, making the escape of the spores easier.

If you take a capsule in the condition represented in Fig. 2 and place it in warm water for a few minutes it will assume the appearance shown in Fig. 1 and no spore can be shaken out, although a careful examination of the contents of the capsule will show that the spores are not wetted, as when mounted in water they are still surrounded by an envelope of air.

The pepperbox is closed, but how? Kerner von Marilaun† states that the teeth when wet curve inwards so strongly that the columella is pressed against the mouth of the capsule, closing it effectually. Five minutes study, however, will show any one that the teeth do not curve in when wet but instead straighten up and outwards; the columella also expands and becomes of nearly the same diameter as the capsule. This makes the openings lateral instead of terminal. The teeth expand enough laterally so that not a single drop of water can enter or a spore escape. In addition the spores seem to be protected by the nature of their outer surface, for it takes a very long soaking to wet the spores so that they can be satisfactorily mounted in water for microscopic study.

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*Rev. Bryologique, 11: 51, 1887. †Nat. Hist. plants, 2: 814.

In those species of *Polytrichum* whose ripe capsules become horizontal or pendent (*P. commune*, *P. juniperinum*, *P. strictum*, *P. piliferum*) there is a crest down the inner face of the teeth which bears cells which are free at their outer ends, or these cells may be united to each other by their extremities. Lindberg, who was the first to accurately describe these structures, compares them to a minute stag's horn attached to the inner surface of each tooth. I do not consider it proven that these crests are accessories developed to prevent a too free delivery of spores in species with pendent capsules, but I do consider the suggestion one worthy of serious consideration

The peristome teeth of the *Polytrichacaeae* like those of *Georgia* have none of the joints or articulations which are so conspicuous in the teeth of most mosses. For this reason Mitten has united these two orders into a group which he calls NEMATODONTEÆ in contrast to the ARTHRODONTEÆ or jointed-toothed mosses. As in *Georgia* the teeth of the Hair-caps consist of a solid mass of cells as is well shown in Fig. A, which shows a cross-section of a tooth of *Polytrichum commune.* These cells are very narrow, elongated, and without transverse walls, these probably having been absorbed during the earlier stages of development. These cells thus form narrow elongated fibres passing up one side of the tooth, forming an arch and then passing down the other side, across through the basal membrane to the next tooth and then up that and so on. If one were to take a pen and trace a continuous line around the edges of the teeth in Pl. 5, Fig 5, it would well represent the course of these fibrous cells which are illustrated in cross section in our figure. These lines can be easily seen by examining the peristome under the compound microscope. The continuous fibres are best seen near the edge of the tooth.

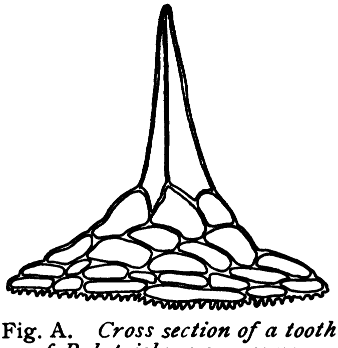

Fig. A. *Cross section of a tooth of Polytrichum commune.*

Plate 5, Figs. 6, 7 and 8 represent different positions of the peristome of *Barbula amplexa* Lesq.* As the peristomes were drawn by reflected light the basal membrane was scarcely noticeable. Fig. 7 shows the peristome immediately after the removal of the operculum. Fig. 8 shows the appearance of the operculum of a dry capsule from which the spores are escaping. The loosely twisted mesh of the narrow teeth forms a perfect sieve to control the escape of the spores. If you place a peristome in this condition under the microscope without mounting medium or cover glass and breathe upon it the teeth will straighten perceptibly. If you dip it in warm water it will assume the original position shown in Fig. 7, if it be comparatively fresh; if it be rather old and somewhat broken it may look like Fig. 6. The perfect cone in Fig. 7 is of course a waterproof covering for the spores inside.

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*As the peristomes were drawn by reflected light, the basal membrane was scarcely noticeable.

In a succeeding paper the structure and development of the peristome of *Barbula* will be taken up.

FISSIDENS GRANDIFRONS, ITS HABITS AND PROPAGATION.

By E. J. Hill.

In July, 1901, *Fissidens grandifrons* Brid., was obtained from the face of a cliff along the Illinois River, near Utica, Ill. It forms part of the ledge famed in Indian legend as "Starved Rock." The bed of moss was kept wet by water oozing from the rock. The stems were uncommonly short, 1.5–4 cm., the average but 2 or 3 cm. long. The leaves were about 3×.4–.5 mm., or about the size of those in specimens from Boyne Falls, Mich. They are smaller than those of robust plants from a creek near Bear Lake, Manistee Co., Mich. (1880), which are 4×.6–.7 mm. These plants were as usual without fruit, but a careful search disclosed a couple of female flowers, one of which is shown (Fig. 1.). There were 10 or 12 archegonia, .6–.8 mm. long. Authorities generally give them as numerous, 30–60 by some. No paraphyses were seen. The perichætial leaves taper rather abruptly from a broadly oval base to a point of variable length, the point in the longer ones similar to the vertical lamina of an ordinary leaf, but relatively narrower. Flowers in *F. grandifrons* are rare. Schimper mentions them as occurring on specimens from Niagara Falls; Boulay, as noticed by Spruce and one or two others on plants from the region of the Pyrenees Mts.; Limpricht, for the territory embraced by his Mossflora, Germany, Austria, and Switzerland, gives only male flowers as occurring. The fruit, as already stated by Mrs. Britton in The Bryologist for July, 1900, has been found but once, in plants from the N. W. Himalayas.

The plants make compensation for this by asexual propagation. Those from "Starved Rock" produce axillary buds which grow into rooting shoots. They are found in all stages of development from those just beginning, to shoots with several pairs of leaves (Fig. 3–6). The rhizoids start when the buds are very small and the leaves scale-like, as short blunt brown processes. They spring from the edges and base of the leaves as well as from the base of the bud-stem and lengthen as the shoot grows. In all cases observed these shoots take the place of branches and ultimately become a rooting branch. Owing to the conditions under which the plants were growing on the cliff, they do not generally become detached but strike root and remain in place, forming new stems to replace the old ones, which are brown